COLSF
7.7.341

[redacted]

ecology and environment, inc.
International Specialists in the Environment

7.2

7.2.3

RESISTIVITY DATA REVIEW
for
ARCS 9 and 10
Contract No. 68-W9-0020
July 17, 1990

Prepared By:

ECOLOGY AND ENVIRONMENT, INC.
101 Yesler Way
Suite 600
Seattle, WA 98104

Prepared For:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Document Control No. ZR6030.1.0

RESISTIVITY DATA REVIEW

DOCUMENT DISTRIBUTION LIST

Name	Title	Affiliation	Date
Neil Thompson	RPM	EPA, Region 10	7/17/90
Sue MacCarthy	Assistant RPM	EPA, Region 10	7/17/90
Ron Karpowicz	Program Manager	E & E, San Francisco	7/17/90

RESISTIVITY DATA REVIEW
for
ARCS 9 and 10

TABLE OF CONTENTS

1.0 INTRODUCTION

A surface geophysical resistivity survey was conducted on February 27 and 28, 1990, by Geo Recon International, Ltd., under the direction of Landau Associates, Inc. (Landau). The resistivity data were collected to assist in interpreting the complex hydrogeologic conditions beneath the Colbert Landfill area.

Ecology and Environment, Inc. (E & E) reviewed the resistivity data and developed this report to summarize the data available, provide an interpretation of the subsurface geology, and make recommendations for future investigative actions at the site. A surface topographic/ geologic map with well and resistivity sounding locations and a geologic fence diagram are provided for reference. All interpretations are based on preliminary data provided by Landau (1990) and data from previous investigations conducted by other consultants.

2.0 DATA SUMMARY

2.1 Previous Survey

The first subsurface geological investigation at Colbert Landfill using geophysical methods was a resistivity survey performed by Lockheed-EMSCO in 1985. The results were documented in a review report submitted by Lockheed-EMSCO to the Environmental Protection Agency (EPA) on August 12, 1985. Monitoring well installation was ongoing during the survey so the interpretation of data was based on limited geologic information. As stated in the review, the interpretation was not intended to be a final analysis due to the lack of geologic controls.

Lockheed-EMSCO interpreted the resistivity sounding data as a three-layer model with a thin surface layer, a thick unsaturated sand layer (highly resistive), and a lower conductive layer. In their survey, a mound of conductive material centered under Elk Chattaroy Road between the landfill and the (b)(6) property was identified. The report indicated that the conductive layer recedes to the east, "into what looks like a paleostream channel that has cut into the clay at depth. This paleochannel could have cut through the upper clay layer, removed it and exposed a lower more conductive clay. The southern end of the "channel" corresponds both in depth and location to two springs located during the data collection phase."

This report is apparently the only documentation available from the Lockheed-EMSCO geophysical survey. Without data, this report is of limited use for further interpretation.

2.2 Recent Survey

Preliminary resistivity data provided by Landau from the February 1990 survey consist of vertical electric sounding (VES) values. These values were recorded using a Schlumberger electrode array and solution values derived by a best fit curve match to a Dar Zarrouk synthetic model. Approximate locations of the sounding nodes are represented on Appendix A.

In general, the data provide useful information for defining subsurface layers that correlate with the upper strata as defined by existing monitoring well geologic information. The data, however, were insufficient to derive an appropriate model for lower subsurface layers that could be correlated to geologic controls. The resistivity sounding was apparently effective in determining the top of the clay layer.

The data provided by Landau were computer modeled at E & E using a synthetic curve match to a pre-determined layered scenario of three and five layers. The three-layer model was used on sounding data collected in areas outside the landfill area where the subsurface lithologies are less complex. A five-layer model was used for data near the landfill, particularly where basalt was encountered in some of the nearby boreholes. The depths calculated by the five-layer model did not correlate with nearby geologic logs. The depth of the upper sand and gravel layer appeared to match the geologic logs, but the deeper layers did not. Curve matching achieved a 7 to 10 percent error for the layered models used. The ideal error percentage of less than 5 percent for routine runs on test data was not reached. More processing time would be required to resolve why the data correlate at the shallow depths, but not at greater depths.

Geologic layers were defined based on the geophysical layered model and hydrologic parameters relative to confining or transmissive lithologies. The geologic layers defined were matched with the lithologic logs from monitoring and domestic wells, and plotted in the form of a fence diagram represented on a map in Appendix B.

3.0 SUBSURFACE GEOLOGY

Earlier site investigations (Golder 1987) provided a model to characterize the basalt present under the landfill and the weathered Latah Formation as a landslide deposit. The basalt and Latah Formation were described as a single hydrologic unit consisting of interbedded basalt slide blocks, sand, and silt/clay lenses. Golder also provided an isopach map of the top of basalt/weathered Latah showing a relative increase in elevation to the northeast. This feature also was characterized in an earlier investigation (Maddox 1982) in which the structural rise was thought to create a barrier to contaminant migration to the northeast. In both reports, unweathered Latah underlies this unit followed by a bedrock of granite.

It is apparent from the subsurface characteristics encountered in wells drilled around the area that the presence of basalt is discontinuous. The lateral extent of basalt is well defined to the west and south by monitoring wells installed during Phase I activities. The extent and character of the basalt is somewhat less defined to the east and north of the landfill. The majority of geologic information about this area comes from driller's logs completed for domestic water wells.

The basalt characterized based on data collected from previous investigations and from Phase I Remedial Design/Remedial Action (RD/RA) activities occurs as a dense section of black basalt or basalt gravels and rubble intermixed with clay or silt. The dense sections of basalt occur beneath the landfill as a "block" that abruptly ends between location CD-20 and location CB-100 in the south and between locations CD-24, CD-4, and CD-46 in the west (Appendix A).

The extent of the basalt block to the north is essentially defined between locations CD-4 and CD-7 and locations CD-21 and CD-24, although basalt does occur again at CD-8 and domestic well (b) (6) Not enough data is available to the north-northeast to confirm a defined boundary for the basalt block or to suggest that a lobe exists.

To the east, the basalt block disappears between CD-20 and CD-22 or between domestic well (b) (6) and CD-22. From west to east, basalt occurs at domestic wells (b) (6) (SE), and (b) (6) (S), and not at CD-22 or CS-14.

The domestic wells were logged by a drilling contractor and the distinction between dense basalt and hard silts, sands, and clays was not made by a geologist. Assuming that the classification is correct, there appears to be a linear pattern of basalt present trending east to west.

In this area, the locations of the resistivity nodes were closer to well locations in which basalt was not encountered during drilling. The node locations also do not extend to the northeast far enough to define this apparent linear feature.

4.0 CONCLUSIONS

The basalt structure beneath Colbert Landfill is well defined to the west and south, but less so to the east and north. The feature was first characterized as a landslide deposit in earlier investigations. A review of the lithologic logs from domestic wells and recently installed monitoring wells suggests that the presence of basalt is sporadic to the northeast of the landfill area. A landslide event could have resulted in the basalt material breaking up into a number of smaller blocks which could explain the apparent random distribution. Post landslide erosion also could increase the sporadic occurrence of basalt. If the basalt feature is a landslide, it may be related to Quaternary landslides of basalt and Latah formation that were mapped (Griggs 1966) as deposits in surrounding areas (Appendix A). Whatever the origin, the basalt block beneath Colbert Landfill can act as a conduit via fractures, rubble zones, or porous sections of vesicular basalt for groundwater (and contaminants) to flow beneath the landfill. The migration of groundwater is then subject to hydraulic flow patterns between the upper and lower aquifers that are now being characterized by Landau.

The influence of the basalt on groundwater flow patterns could be determined by examining the piezometric effect at various points in the aquifer while pumping from the basalt aquifer. This can be accomplished during the Phase I pilot pumping operations at CP-E2 with an appropriate monitoring program. The results of the monitoring program can be used to track flow patterns and estimate the effectiveness of extracting contaminants distributed at various depths within the aquifer. Therefore, it is recommended that a well-defined monitoring program be planned and administered for this purpose.

REFERENCES

George Maddox & Associates, 1982, Geohydrologic Investigations of Colbert Landfill - Phase II, submitted to Spokane County Utilities Department.

Golder Associates, 1987, Remedial Investigation Report for the Colbert Landfill Spokane, Washington, submitted to State of Washington, Department of Ecology.

Griggs, A.B., 1966, Reconnaissance Geologic May of the West Half of the Spokane Quadrangle Washington and Idaho, U.S. Geological Survey Miscellaneous Geologic Investigations Map I-464.

Landau Associates, March 28, 1990, Letter submitted from L.D. Beard to L.D. Diediker, Colbert Landfill RD/RA Geophysical Survey Data, data attachments.

Lockheed-EMSCO, August 12, 1985, Letter submitted from M.G. Gibbons (Lockheed) to Mr. J.J. Van Ee, report enclosed Colbert Landfill Interim Report Geophysical Data - Spokane County, Washington.

APPENDIX A

GEOLOGIC MAP OF AREA SURROUNDING COLBERT LANDFILL

TARGET SHEET: Oversized Document

This document was not imaged due to the original being oversized. Oversized documents are located at the Superfund Records Center. Please contact the Records Center Help Desk at 206-553-4494 for assistance.

If this oversized material is part of another document, fill out below information:

This oversized document is a part of Doc ID: 1414394

Oversized Document Title (if any):

1414395

Region 10
1200 Sixth Ave.
Seattle, WA 98101

APPENDIX B

GEOLOGIC FENCE DIAGRAM

TARGET SHEET: Oversized Document

This document was not imaged due to the original being oversized. Oversized documents are located at the Superfund Records Center. Please contact the Records Center Help Desk at 206-553-4494 for assistance.

If this oversized material is part of another document, fill out below information:

This oversized document is a part of Doc ID: 1414394

Oversized Document Title (if any):

1414396

Region 10
1200 Sixth Ave.
Seattle, WA 98101